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(54) Title: METHOD AND APPARATUS FOR LOCATING A DIGITAL CONTROL CHANNEL IN A DOWNBANDED CELLULAR RADIOCOMMUNICATION SYSTEM

(57) Abstract

A method and system for locating control channels, particularly digital control channels, are described. By grouping the channels which are candidates for carrying supervisory messages in blocks indicative of their relative likelihood for being used as control channels, a mobile station can begin its search for a control channel with channels which are most likely to actually be control channels.

1

METHOD AND APPARATUS FOR LOCATING A DIGITAL CONTROL CHANNEL IN A DOWNBANDED CELLULAR RADIOCOMMUNICATION SYSTEM

BACKGROUND

5   The present invention relates generally to radiocommunication systems having control channels and, more particularly, to the location of digital control channels in downbanded cellular radiocommunication systems.

10   Cellular systems have traditionally been analog in nature. The rapid growth of radiocommunication systems, however, has compelled system designers to search for ways in which system capacity can be increased without reducing communication quality beyond consumer tolerance

15   thresholds. One way in which increased capacity can be provided is by changing from analog to digital communication techniques. In North America, this change was implemented by transitioning from systems specified by the analog AMPS standard to digital systems (D-AMPS) which

20   has been standardized in technical requirements documents promulgated by the Telecommunications Industry Association, specifically TIA/EIA IS-54B and, subsequently, IS-136.

        Since a large consumer base having equipment that

25   operated only in the analog domain existed prior to the introduction of digital techniques, a dual-mode (analog and digital) Cellular standard was adopted in IS-54B so that analog compatibility was provided in tandem with digital communication capability. For example, the IS-54B

30   standard provides for both analog and digital traffic channels, wherein the system operator can replace analog traffic channels with digital traffic channels, and vice-versa, in a dynamic manner to accommodate fluctuating traffic patterns among analog and digital users.

2

In addition to traffic channels, Cellular systems also provide control channels which are used to carry call setup data messages between base stations and mobile stations. According to IS-54B, for example, there are 21

5 dedicated analog control channels which are assigned to fixed frequencies for each of the A and B carriers. These analog control channels are termed "dedicated" since they are always found at the same frequency and, therefore, can be readily located by the mobile stations which need to

10 monitor the data which is transmitted thereon.

For example, when in the idle state (i.e., turned on but not in use), a mobile station in a Cellular system designed in accordance with IS-54B tunes to and then continuously monitors the strongest control channel at its

15 known frequency (generally, the control channel of the cell in which the mobile station is located at that moment) and may receive or initiate a telephone call through the corresponding base station. When moving between cells while in the idle state, the mobile station

20 will eventually "lose" radio connection on the control channel of the "old" cell and tune to the control channel of the "new" cell. The initial tuning to, and the change of, control channel are both accomplished automatically by scanning all the control channels at their known

25 frequencies in the Cellular system to find the "best" control channel. When a control channel with good reception quality is found, the mobile station remains tuned to this channel until the quality deteriorates again. In this manner, all mobile stations are nearly

30 always "in touch" with the system.

As such hybrid systems mature, it is anticipated that the number of analog users will diminish and the number of digital users will increase. Eventually all of the analog traffic channels will probably be replaced by digital

35 traffic channels. When that occurs, less expensive

digital-only mobile units can replace the current dual-mode units. However, such digital-only mobile units would be unable to scan the analog control channels currently provided in the IS-54B system.

5   Accordingly, it is desirable to provide digital control channels to radiocommunication systems which support digital technology, such as that described by IS-136. In addition to compatibility issues, digital control channels are also desirable for other reasons described in
10   the above-identified applications, for example an enhanced sleep mode for mobile units which results in longer battery life. Whereas IS-54B provides control channels on fixed frequencies, more flexibility is desirable in assigning the number of control channels and the
15   frequencies for these control channels to optimize system capacity and to support hierarchical cell structures, i.e., microcells, picocells, etc. If, however, the digital control channels are not located on known frequencies, the question arises as to how the remote
20   units will be able to locate these control channels for monitoring. The parent application (U.S. Patent Application Serial No. 08/331,711) describes several exemplary techniques for locating digital control channels which may be assigned to arbitrary frequencies within the
25   Cellular frequency bands.
          Even with the implementation of more spectrally efficient technologies, the capacity of Cellular communication systems continues to be a concern due to the unexpectedly rapid growth in subscriber bases. Another
30   way in which the capacity of Cellular communications system can be increased is to provide additional spectrum. For example, the FCC originally allocated two blocks of frequencies (i.e., 825-845 MHz (uplink) and 870-890 MHz (downlink)) for Cellular service in the United States. In
35   1987, the FCC allocated an additional 5 MHz to each block

4

to increase Cellular system capacity in response to consumer demand. Of course, this solution has natural limits since the usable frequency spectrum is limited and other, existing communication systems already own some of
5   the spectrum bandwidth.

Another solution is described in U.S. Patent Application Serial No. 08/622,311 , entitled "Downbanded Cellular Systems and Methods", filed on the same day as this application, the disclosure of which is expressly
10   incorporated here by reference. Therein, techniques are described for adapting the portion of the spectrum allocated by the FCC to Land Mobile Radio (LMR) for usage as additional downbanded cellular (DBC) channels to supplement and/or complement the capacity achievable using
15   only the Cellular bandwidth. LMR systems are typically used to provide radio communication service between individual units of a particular organization. For example, police departments use a version of LMR (commonly referred to as public service trunked (PST) systems) to
20   communicate between patrol cars and headquarters. Unlike Cellular systems, however, LMR systems have historically been implemented as large independent sites serviced by one (or a few) transmitting base stations, rather than over a wide geographical area serviced by many
25   transmitting base stations as in Cellular systems. At each LMR site, an operator is allocated a portion of the LMR spectrum within which the operator selects a fixed frequency to be used for the control channel while all of the other frequencies can be used for traffic. Thus, in
30   conventional LMR systems a remote unit is typically programmed with a primary control channel frequency to which it locks when turned on or reset. Alternate control channel frequencies can also be programmed into the remote units to accommodate situations where the primary control
35   channel is malfunctioning or taken out of service (e.g,

for maintenance of the transmitting unit).

If, however, the LMR spectrum is to be used to provide downbanded cellular capability that is compatible with existing standards for digital control channels

5   (e.g., TIA/EIA IS-136) as described in the "Downbanded Cellular Systems and Methods" patent application, there exists a need for providing remote units which are capable of locating such digital control channels regardless of which frequencies (e.g., LMR or Cellular band) are used to

10   support these control channels.

SUMMARY

These and other drawbacks and limitations of conventional systems and methods are overcome according to

15   the present invention wherein digital control channel location is expedited by, for example, prescribing a search pattern based on a relative likelihood of finding a digital control channel on a particular DBC channel or group of DBC channels. According to exemplary embodiments

20   of the present invention, channels are grouped into probability blocks which are ranked in accordance with the relative likelihood of finding the digital control channel in each block. A mobile unit can then look for a digital control channel within a highest ranked probability block,

25   followed by a second highest ranked probability block and so on, until a digital control channel is located. This process can, for example, be used when the mobile station has no information regarding the frequency which is being used as a control channel in the mobile station's current

30   geographic location, e.g., the first time that a mobile station is turned on in a new area.

According to another exemplary embodiment of the present invention, after initial control channel acquisition a predetermined number of control channel

35   frequencies are stored in a memory of the mobile unit.

6

Control channel frequencies can be stored on an as-
acquired basis or on an as-identified basis, depending
upon a user's preference. For example, each time the
mobile station actually locks onto a control channel
5   (i.e., selects a control channel as the active control
channel) that control channel can be stored in a FIFO
buffer. If stored on an as-identified basis, control
channel frequencies can also be added to the FIFO buffer
when the mobile station is informed of other control
10   channels, e.g., when it receives a neighbor list for cell
reselection measurement. The stored list is then used the
next time that the mobile station is turned on to expedite
control channel acquisition.

BRIEF DESCRIPTION OF THE DRAWINGS

15   The foregoing, and other, objects, features and
advantages of the present invention will be more readily
understood upon reading the following detailed description
in conjunction with the drawings in which:
         Figure 1(a) illustrates a DBC system adjacent to a
20   Cellular system;
         Figure 1(b) illustrates a DBC system that is
physically coincident with a Cellular system;
         Figure 2 is a block diagram of a portion of an
exemplary radio communication system according to the
25   present invention;
         Figure 3 is a table which shows a first exemplary
probability block scheme according to the present
invention;
         Figure 4 is a table which shows a second exemplary
30   probability block scheme according to the present
invention;
         Figure 5(a) shows a portion of a third exemplary
probability block scheme according to the present
invention;

Figure 5(b) completes the table of Figure 5(a);

Figure 6 illustrates an exemplary FIFO buffer which can be used to reduce control channel acquisition time according to an exemplary embodiment of the present invention;

Figure 7 is a flow chart illustrating an exemplary method for acquiring control channels according to the present invention;

Figure 8(a) is an exemplary frame format for a digital traffic channel; and

Figure 8(b) is an exemplary frame format for a digital control channel.

DETAILED DESCRIPTION

Figure 1(a) illustrates one contemplated application of DBC systems. In the figure, a DBC system is positioned adjacent to a Cellular system. The DBC system is illustrated as having a plurality of cells each of which are supported by a mobile switching center (MSC) 10. Similarly, the Cellular system has a plurality of cells supported by three MSCs 12, 14 and 16. Each cell includes one or more base stations (not shown) connected to its respective MSC for transmitting signals to, and receiving signals from, mobile stations within the cell. In this exemplary configuration, the DBC system provides additional geographic coverage which would allow, for example, the operator of the Cellular system to provide greater geographic service to its customers.

Another example is illustrated in Figure 1(b). Therein, each of the larger circles and ellipses represents a Cellular system and each of the smaller circles within Cellular system 20 represents a DBC system. Thus, this example illustrates a case where DBC systems are coincident with a Cellular system and can be used to supplement the Cellular system's capacity.

8

Having described exemplary applications of DBC
systems at a cell level, some general details of base
stations and mobile stations are provided to round out
this discussion, but without providing an unnecessary
5   amount of detail that might obscure the present invention.
Those skilled in the art will appreciate that DBC base
stations and mobile stations can be manufactured using
substantially the same components as conventional Cellular
base stations and mobile stations, with certain
10 exceptions, e.g., DBC equipment will have the rf
capability to operate in the LMR frequency band. Readers
interested in obtaining additional information relating to
more specific details of exemplary mobile and base station
implementations are directed to copending U.S. Patent
15 Application Serial No. 07/967,027 entitled "Multi-Mode
Signal Processing" filed on October 27, 1992 to P. Dent
and B. Ekelund, which disclosure is incorporated here by
reference.

Figure 2 represents a block diagram of a portion of
20 an exemplary downbanded cellular radiocommunication system
according to one embodiment of the present invention which
can be used to implement the foregoing. The system shows
an exemplary base station 110 and a mobile 120. The base
station includes a control and processing unit 130 which
25 is connected to the MSC 140 which in turn is connected to
the public switched telephone network (not shown).

The base station 110 for a cell includes a plurality
of voice channels handled by voice channel transceiver 150
which is controlled by the control and processing unit
30 130. Also, each base station includes a control channel
transceiver 160 which may be capable of handling more than
one control channel. The control channel transceiver 160
is controlled by the control and processing unit 130. The
control channel transceiver 160 broadcasts control
35 information over the control channel of the base station

or cell to mobiles locked to that control channel. The
voice channel transceiver handles the traffic or voice
channels. When the mobile 120 first enters the idle mode,
it will locate a DBC control channel from which it can
5   acquire overhead information and listen for pages. In
conventional LMR systems, a control channel was identified
by the processing unit 180 tuning the mobile station's
voice/control channel transceiver 170 to a control
channel, which control channel has been preprogrammed into
10   the mobile station by the network operator. This
technique, however, is not appropriate for DBC systems in
which control channels can be placed on any DBC channel
frequency.

        According to exemplary embodiments of the present
15   invention, several techniques can be used to expedite the
acquisition of a DBC control channel by the mobile
station. One technique which can be used to aid the
mobile in searching for a digital control channel is to
group the available frequencies into blocks which are
20   assigned different probabilities that reflect the relative
likelihood of finding a digital control channel in each
block. In this manner, the time required for service
acquisition by the mobile station may be significantly
decreased as compared with, for example, starting with a
25   first numbered channel in the LMR spectrum and reading
each channel in numbered order until a control channel is
found. The table depicted in Figure 3 is one example of
how the channels in the LMR hyperband can be assigned
different relative probabilities for supporting digital
30   control channel acquisition. In this example, the LMR
spectrum is divided into 16 blocks all but the first
(lowest probability) of which include 37 channels. Both
channel numbers and transmit frequencies are provided.
Readers interested in how these frequencies were
35   determined and other aspects of DBC channelization of the

LMR spectrum are referred to the above-incorporated patent application entitled "Downbanded Cellular Systems and Methods". A mobile station using the exemplary probability block scheme of Figure 3 would first scan the channels in block #10. If a control channel is not located within this first block of 37 channels, then the mobile station would next scan the channels associated with block #6, and so on until a DBC control channel is found. A more detailed example of this process is provided below.

Figure 4, and Figures 5(a) and 5(b) jointly, present two other examples of ways in which the LMR portion of the spectrum can be grouped into probability blocks of frequencies. For example, the probability block scheme illustrated in Figure 4 can be used if the LMR spectrum is separated into three different bands or channel groups so that a mobile station looks for a control channel in its assigned band. Similarly, Figures 5(a) and 5(b) provide an exemplary probability block scheme for the LMR spectrum should it be subdivided into four channel groups as shown. Those skilled in the art will appreciate that these channel groupings are merely exemplary and that any other groupings could be accommodated using the disclosed techniques. These probability block techniques can be used by a mobile station as a starting point for digital control channel location when, for example, the mobile station first powers on in a DBC system or at any other time that the mobile station cannot locate a control channel using other information. An example of how other control channel information can be obtained by a mobile station and used to further reduce control channel acquisition time is described below.

According to another aspect of the present invention, a FIFO based control channel scanning list is retained in the mobile station to further expedite control channel

11

acquisition.   According to one exemplary embodiment,
illustrated in Figure 6, a FIFO buffer 60 can be provided
in the mobile station which stores the last N (e.g., 24)
control channels (CCs) which have been locked to by the
5   mobile station. For example, as a mobile station in the
idle mode moves from one cell to another, it will lock
onto the control channel associated with the new cell
using well known cell reselection techniques. The newly
acquired control channel will be input to the FIFO buffer,
10   thereby displacing all of the current entries in the FIFO
buffer 60 by one. If the FIFO buffer 60 is full, then the
twenty-fourth entry will be displaced out of the buffer.
DBC mobile stations can use the list of control channels
as follows. When a mobile station is activated, it will
15   first check the FIFO buffer 60 to determine if any control
channels are listed therein and will attempt to lock on to
the listed control channels in the order that they are
stored in the FIFO (i.e., N to 1). If, as is frequently
the case, a subscriber travels within a repeated pattern
20   of cells, then it is likely that one of the N stored
control channels will be accessible at power on of the
mobile station. Alternatively, if the mobile station
cannot locate any of the control channels identified in
the FIFO buffer 60, or if no control channels are listed
25   in the FIFO buffer 60, then the mobile station will use
the above-described techniques for finding control
channels using a stored probability block scheme.

       According to another exemplary embodiment of the
present invention, the FIFO buffer 60 will not only store
30   those control channels that the mobile station has
acquired, but also any other control channels of which it
becomes aware. For example, the network may forward a
neighboring list of control channels which are associated
with base stations adjacent cells. This neighboring list
35   may be used for measurement purposes to determine, for

12

example, when the mobile station should reselect another cell's control channel. In any event, this neighboring list of control channels can also be added to the FIFO buffer for storage and later use in control channel acquisition as described above. The desirability of adding control channels which are identified but not acquired may depend on the movement patterns of each mobile station and, therefore, may be added to the FIFO buffer 60 at the user's option by way of a selectable menu item provided as part of the user interface of the mobile station.

Having described exemplary techniques which can be used to expedite the location of a DBC control channel, other exemplary embodiments of the present invention will now be described wherein these techniques are applied in various situations. For example, and with reference to the flow chart of Figure 7, suppose that a mobile station is seeking a DBC control channel on the A-Band of a DBC system in which the probability block scheme of Figure 4 is employed. As shown at block 72, the mobile will first examine, assuming that no other information is available in the mobile station (block 74), the channels within the highest ranked probability block, for example, block #8 having channel numbers 78-87 in Figure 4. Within this block of channels, the mobile will select a first channel to read based on some predetermined criteria. For example, as described in block 76, this criteria can be the measured signal strength of the channels within the probability block. Alternately, the channels could be read in numbered order within the block. Thus, the mobile measures the signal strength (RSSI) of channels 78-87 and ranks them in order from strongest to weakest. The highest signal strength channel, denoted channel 'X' for this discussion, is then selected for reading at block 78. In an all-digital system, this channel will either be a

13

digital traffic channel (DTC) or a digital control channel (DCC). If the selected channel 'X' is identified as a DCC at block 80, then the process ends. If, on the other hand, channel 'X' is a DTC, then the flow returns to block
5　　78 where the next highest ranked channel is selected for reading. The identification of a channel as either a DTC or DCC can be performed in a variety of ways.

As an example for distinguishing between a digital traffic channel and a digital control channel, the
10　　signalling format described in IS-54B standard will again be used as an illustrative reference. Although the IS-54B digital traffic channel and digital control channel downlink slot format have structural commonality, as seen in Figures 8(a) and 8(b), there are also certain
15　　differences which allow for distinguishing a digital control channel from a digital traffic channel. First, because of the differences in the channel coding of the digital verification color code (DVCC) and superframe (SFP) fields, there are always 4 bits out of 12 which are
20　　different in every pair of CDVCC and CSFP codewords regardless of which CDVCC or CSFP codeword is transmitted by a base station (bit errors introduced due to radio channel impairments, however, may change the extent to which transmitted codewords differ once they are received
25　　by a mobile station). More specifically, the four check bits of the SCFP are inverted relative to the check bits of the CDVCC. Secondly, the CDVCC content is fixed from slot to slot on a digital traffic channel whereas the content of the CSFP changes in a predictable fashion from
30　　slot to slot on a digital control channel.

Another distinction which could be used is that the channel coding and interleaving employed on a digital traffic channel is different from that employed on a digital control channel regardless of the DTC service
35　　(speech or FACCH). For example, the digital traffic

14

channel might use 1/2 rate coding while the digital control channel uses 1/4 rate coding. Moreover, the IS-54B SACCH and RESERVED fields have different functionality on a digital control channel. The actual function of each of the fields illustrated in Figures 8(a) and 8(b) is not germane to the present discussion, however, for a more detailed explanation of the functionality of these fields reference is made to the above-incorporated applications.

If one or more control channels are listed in the FIFO buffer 60 as determined at block 74, then the flow moves along the "yes" branch. At block 82, the mobile unit will then operate its transceiver to scan each of the control channels in FIFO buffer 60 in sequence. If a control channel is found at block 84, then the process ends. Otherwise, when all of the control channels identified in the FIFO buffer 60 had been eliminated from consideration, the mobile station will then revert to a probability block approach to locating a control channel as the flow moves to block 72.

The above-described exemplary embodiments are intended to be illustrative in all respects, rather than restrictive, of the present invention. Although the foregoing exemplary embodiments have been described in terms of base and mobile stations, the present invention can be applied to any radiocommunication system. For example, satellites could transmit and receive data in communication with the remote devices using DBC channels.

Thus the present invention is capable of many variations in detailed implementation that can be derived from the description contained herein by a person skilled in the art. All such variations and modifications are considered to be within the scope and spirit of the present invention as defined by the following claims.

15

CLAIMS:

1.   A method for locating a DBC control channel
among a plurality of DBC channels comprising the steps of:
        grouping said plurality of DBC channels into a
5   plurality of blocks;
        ranking each of said blocks based upon a
relative likelihood of finding said DBC control channel
therein; and
        investigating DBC channels within a highest
10   ranked block to locate a DBC control channel.

2.   The method of claim 1, wherein said plurality of
DBC channels have center frequencies in the range between
851 and 869 MHz.

3.   A radiocommunication system comprising:
15   a base station which communicates with mobile
stations using a plurality of DBC channels, said DBC
channels grouped into a plurality of blocks which are
ranked based upon a relative likelihood of finding a DBC
control channel in each block; and
20   means, in said mobile stations, for
investigating DBC channels in said blocks based upon said
ranking.

4.   The radiocommunication system of claim 3,
wherein said plurality of DBC channels have center
25   frequencies in the range between 851 and 869 MHz.

5.   A method for locating a DBC control channel in
a radiocommunication system having a plurality of DBC
channels comprising the steps of:
        grouping said plurality of DBC channels into a
30   plurality of blocks;

16

ranking each of said blocks based upon a relative likelihood of finding said DBC control channel therein;

reading a DBC channel within a highest ranked
5   one of said blocks;

determining if said read DBC channel is a traffic channel; and

continuing, if said read DBC channel is not a traffic channel, to read and determine DBC channels in
10 said highest ranked one of said blocks until a DBC control channel is located.

6.   The method of claim 5, wherein said plurality of DBC channels have center frequencies in the range between 851 and 869 MHz.

15   7.   A method for locating a DBC control channel among a plurality of DBC channels comprising the steps of:

grouping said plurality of DBC channels into a plurality of blocks;

ranking each of said blocks based upon a
20 relative likelihood of finding said DBC control channel therein;

reading channels within a highest ranked block to locate a DBC control channel;

storing an identifier of said DBC control
25 channel in a memory device;

storing identifiers of any subsequently acquired DBC control channels in said memory device; and

using said stored identifiers in said memory device to locate a next DBC control channel.

30   8.   The method of claim 7, wherein said plurality of DBC channels have center frequencies in the range between 851 and 869 MHz.

17

9.   The method of claim 7, wherein said steps of storing further comprise the step of:

providing, as said memory device, a FIFO buffer wherein a predetermined number of previously acquired DBC control channel identifiers are stored.

10.   The method of claim 5, wherein said step of determining if said read DBC channel is a traffic channel further comprises the steps of:

identifying a field in a time slot of a channel which is either a CDVCC field or a CSFP field, depending upon whether said channel is a digital traffic channel or a digital control channel, respectively;

determining whether said field has check bits which are inverted relative to check bits of a digital traffic channel; and

characterizing said channel as a digital control channel if said check bits are inverted, otherwise characterizing said channel as a digital traffic channel.

11.   The method of claim 5, wherein said step of determining if said read DBC channel is a traffic channel further comprises the steps of:

receiving and decoding a field in a DBC channel which has been broadcast over an air interface;

determining if error correction bits in said field are inverted relative to a predetermined set of error correction bits; and

identifying said DBC channel as a traffic channel or as a DBC control channel based upon said step of determining.

12.   The method of claim 5, wherein said step of determining if said read DBC channel is a traffic channel

18

further comprises the steps of:

identifying said DBC channel as a DBC control channel if a convolutional encoding rate of said DBC channel is a first rate and for identifying said DBC channel as a traffic channel if said convolutional coding rate is a second rate.

13. The method of claim 12, wherein said first rate is 1/4 and said second rate is 1/2.

14. A mobile station comprising:

a transceiver for transmitting and receiving radio signals over an air interface;

a memory device including a first storage area for a probability block scheme and a second storage area for storing control channel identifiers;

a processor for acquiring a DBC control channel using information stored in said memory device.

15. The mobile station of claim 14, wherein said processor first uses said stored control channel identifiers, if any, to acquire said DBC control channel and then, if unsuccessful, uses said probability block scheme to acquire said DBC control channel.

16. The mobile station of claim 14, wherein said DBC control channel has a center frequency between 851 MHz and 869 MHz.

17. The mobile station of claim 14, wherein said second storage area is a FIFO buffer.

DBC SYSTEM

CELLULAR SYSTEM

FIG. 1(a)

CELLULAR SYSTEM
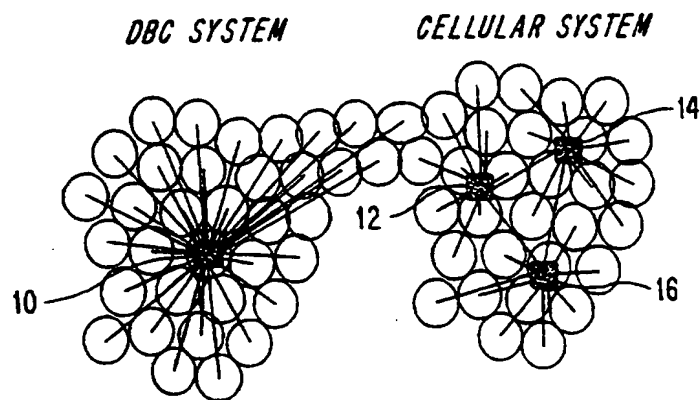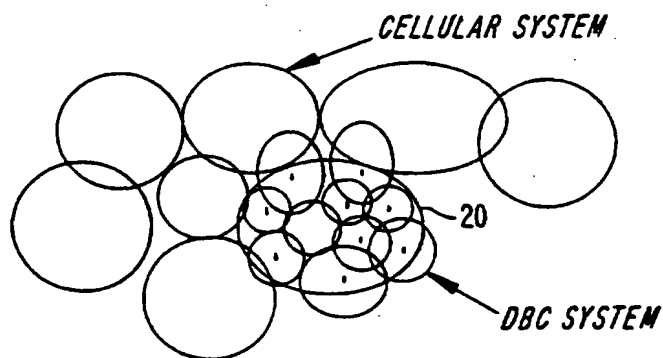
FIG. 1(b)

FIG. 2
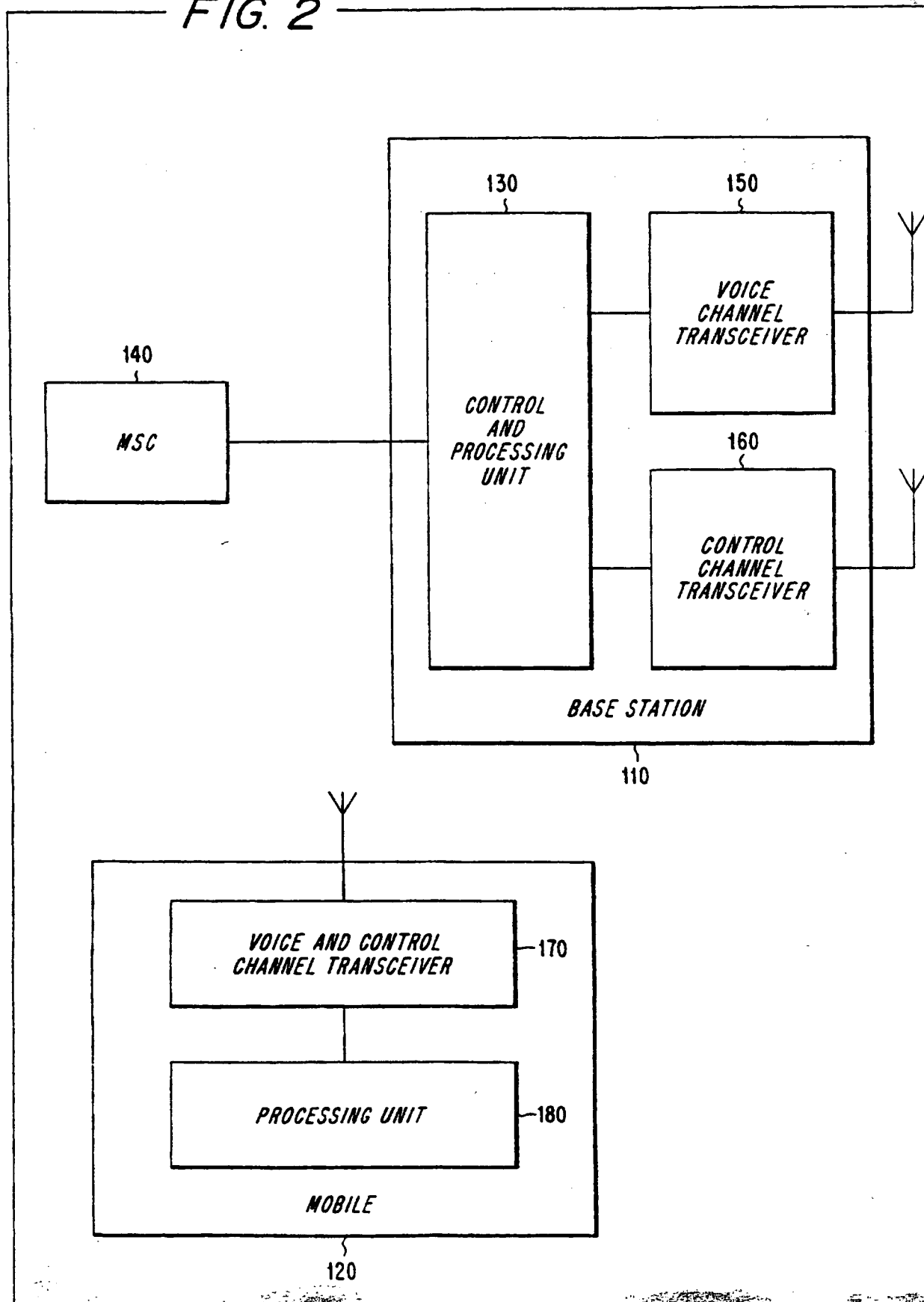
FIG. 3

BLOCK #	START CHN	END CHN	NUM CHAN	TX BOT	TX TOP	RELATIVE PROBABILITY	
1	1	45	45	851.01	852.33	16	LOWEST
2	46	82	37	852.36	853.44	12	
3	83	119	37	853.47	854.55	11	
4	120	156	37	854.58	855.66	10	
5	157	193	37	855.69	856.77	6	
6	194	230	37	856.8	857.88	2	
7	231	267	37	857.91	858.99	4	
8	268	304	37	859.02	860.1	8	
9	305	341	37	860.13	861.21	9	
10	342	378	37	861.24	862.32	1	HIGHEST
11	379	415	37	862.35	863.43	3	
12	416	452	37	863.46	864.54	5	
13	453	489	37	864.57	865.65	7	
14	490	526	37	865.68	866.76	13	
15	527	563	37	866.79	867.87	14	
16	564	600	37	867.9	868.98	15	

FIG. 4

BLOCK #	START CHN	END CHN	NUM CHAN	LMR BAND	TX BOT	TX TOP	RELATIVE PROBABILITY	
		RCI=2	# CHAN GRPS=3					
1	1	17	17	A	851.01	851.49	16	LOWEST
2	18	27	10	A	851.52	851.79	13	
3	28	37	10	A	851.82	852.09	11	
4	38	47	10	A	852.12	852.39	8	
5	48	57	10	A	852.42	852.69	6	
6	58	67	10	A	852.72	852.99	4	
7	68	77	10	A	853.02	853.29	2	
8	78	87	10	A	853.32	853.59	1	HIGHEST
9	88	97	10	A	853.62	853.89	3	
10	98	107	10	A	853.92	854.19	5	
11	108	117	10	A	854.22	854.49	7	
12	118	127	10	A	854.52	854.79	9	
13	128	137	10	A	854.82	855.09	10	
14	138	147	10	A	855.12	855.39	12	
15	148	157	10	A	855.42	855.69	14	
16	158	167	10	A	855.72	855.99	15	
1	168	185	18	B	856.02	856.53	16	LOWEST
2	186	206	21	B	856.56	857.16	14	
3	207	227	21	B	857.19	857.79	13	
4	228	248	21	B	857.82	858.42	11	
5	249	269	21	B	858.45	859.05	8	
6	270	290	21	B	859.08	859.68	6	
7	291	311	21	B	859.71	860.31	4	
8	312	332	21	B	860.34	860.94	2	
9	333	353	21	B	860.97	861.57	1	HIGHEST
10	354	374	21	B	861.6	862.2	3	
11	375	395	21	B	862.23	862.83	5	
12	396	416	21	B	862.86	863.46	7	
13	417	437	21	B	863.49	864.09	9	
14	438	458	21	B	864.12	864.72	10	
15	459	479	21	B	864.75	865.35	12	
16	480	500	21	B	865.38	865.98	15	
1	501	510	10	C	866.01	866.28	16	LOWEST
2	511	516	6	C	866.31	866.46	13	
3	517	522	6	C	866.49	866.64	11	
4	523	528	6	C	866.67	866.82	8	
5	529	534	6	C	866.85	867	6	
6	535	540	6	C	867.03	867.18	4	
7	541	546	6	C	867.21	867.36	2	
8	547	552	6	C	867.39	867.54	1	HIGHEST
9	553	558	6	C	867.57	867.72	3	
10	559	564	6	C	867.75	867.9	5	
11	565	570	6	C	867.93	868.08	7	
12	571	576	6	C	868.11	868.26	9	
13	577	582	6	C	868.29	868.44	10	
14	583	588	6	C	868.47	868.62	12	
15	589	594	6	C	868.65	868.8	14	
16	595	600	6	C	868.83	868.98	15	

FIG. 5(a)

BLOCK #	START CHN	RCI = 2 END CHN	# CHAN GRPS = 4 NUM CHAN	LMR BAND	TX BOT	TX TOP	RELATIVE PROBABILITY
1	1	17	17	A	851.01	851.49	16
2	18	27	10	A	851.52	851.79	13
3	28	37	10	A	851.82	852.09	11
4	38	47	10	A	852.12	852.39	8
5	48	57	10	A	852.42	852.69	6
6	58	67	10	A	852.72	852.99	4
7	68	77	10	A	853.02	853.29	2
8	78	87	10	A	853.32	853.59	1
9	88	97	10	A	853.62	853.89	3
10	98	107	10	A	853.92	854.19	5
11	108	117	10	A	854.22	854.49	7
12	118	127	10	A	854.52	854.79	9
13	128	137	10	A	854.82	855.09	10
14	138	147	10	A	855.12	855.39	12
15	148	157	10	A	855.42	855.69	14
16	158	167	10	A	855.72	855.99	15
1	168	184	17	B	856.02	856.5	16
2	185	194	10	B	856.53	856.8	13
3	195	204	10	B	856.83	857.1	11
4	205	214	10	B	857.13	857.4	8
5	215	224	10	B	857.43	857.7	6
6	225	234	10	B	857.73	858	4
7	235	244	10	B	858.03	858.3	2
8	245	254	10	B	858.33	858.6	1
9	255	264	10	B	858.63	858.9	3
10	265	274	10	B	858.93	859.2	5
11	275	284	10	B	859.23	859.5	7
12	285	294	10	B	859.53	859.8	9
13	295	304	10	B	859.83	860.1	10
14	305	314	10	B	860.13	860.4	12
15	315	324	10	B	860.43	860.7	14
16	325	334	10	B	860.73	861	15

FIG. 5(b)

BLOCK #	START CHN	END CHN	NUM CHAN	LMR BAND	TX BOT	TX TOP	PROBABILITY
1	335	350	16	C	861.03	861.48	16
2	351	360	10	C	861.51	861.78	13
3	361	370	10	C	861.81	862.08	11
4	371	380	10	C	862.11	862.38	8
5	381	390	10	C	862.41	862.68	6
6	391	400	10	C	862.71	862.98	4
7	401	410	10	C	863.01	863.28	2
8	411	420	10	C	863.31	863.58	1
9	421	430	10	C	863.61	863.88	3
10	431	440	10	C	863.91	864.18	5
11	441	450	10	C	864.21	864.48	7
12	451	460	10	C	864.51	864.78	9
13	461	470	10	C	864.81	865.08	10
14	471	480	10	C	865.11	865.38	12
15	481	490	10	C	865.41	865.68	14
16	491	500	10	C	865.71	865.98	15
1	501	510	10	D	866.01	866.28	16
2	511	516	6	D	866.31	866.46	13
3	517	522	6	D	866.49	866.64	11
4	523	528	6	D	866.67	866.82	8
5	529	534	6	D	866.85	867	6
6	535	540	6	D	867.03	867.18	4
7	541	546	6	D	867.21	867.36	2
8	547	552	6	D	867.39	867.54	1
9	553	558	6	D	867.57	867.72	3
10	559	564	6	D	867.75	867.9	5
11	565	570	6	D	867.93	868.08	7
12	571	576	6	D	868.11	868.26	9
13	577	582	6	D	868.29	868.44	10
14	583	588	6	D	868.47	868.62	12
15	589	594	6	D	868.65	868.8	14
16	595	600	6	D	868.83	868.98	15

FIG. 6

MOST RECENTLY ACQUIRED CC_N
CC_{N-1}
CC_{N-2}
.
.
.
CC_1

— 60
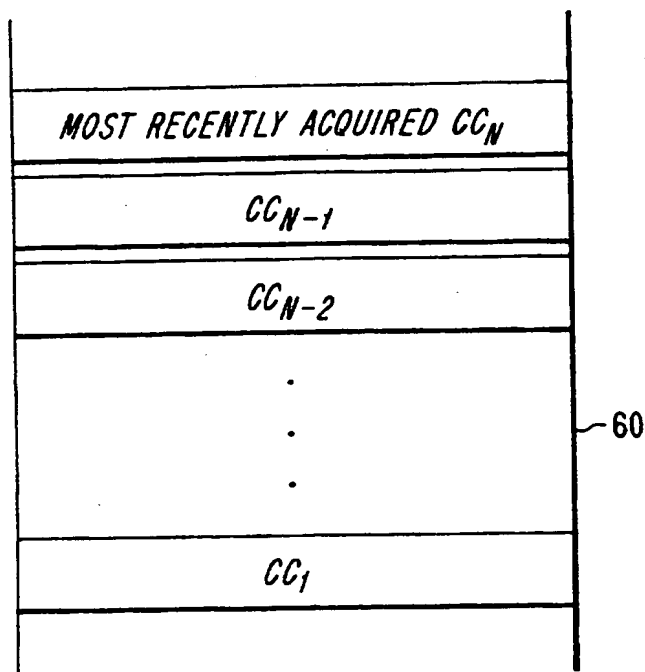
FIG. 8(a)

SYNC	SACCH	DATA	CDVCC	DATA	RSVD=0	CDL
28	12	130	12	130	1	11

FIG. 8(b)

SYNC	SCF	DATA	CSFP	DATA	SCF	RSVD
28	12	130	12	130	10	2
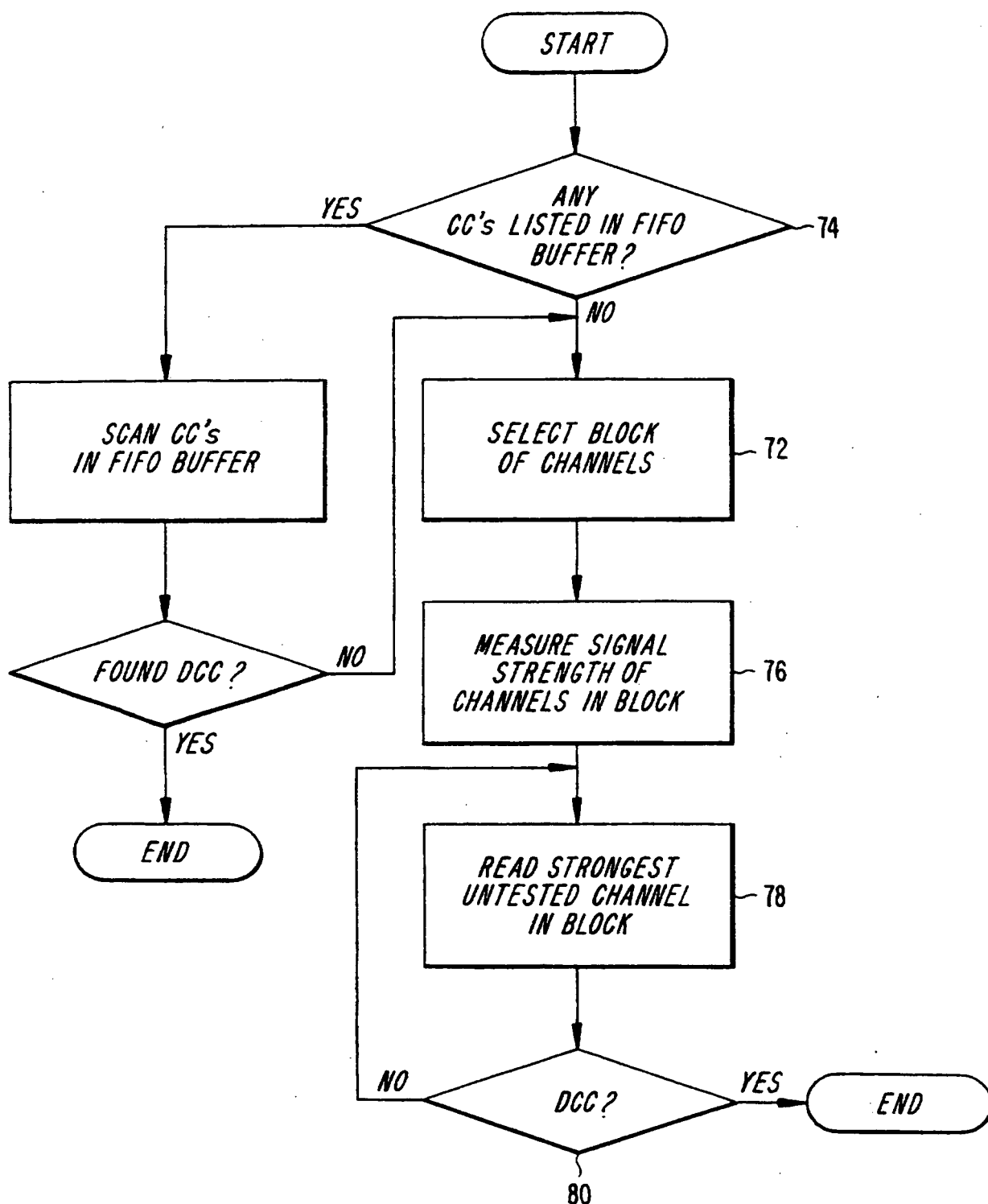
FIG. 7

INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6   H04Q7/38

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6   H04Q

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	WO 95 12936 A (ERICSSON TELEFON AB L M ;HENRY RAY (US)) 11 May 1995 cited in the application see page 6, line 28 - page 8, line 3; claims 31-36,57-66; figures 1-3,5 ---	1,3,5,7, 10-14
Y	US 5 119 397 A (DAHLIN JAN E A S ET AL) 2 June 1992 see column 3, line 48 - line 66; figure 1 -----	1,3,5,7, 10-14

[ ] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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"A" document defining the general state of the art which is not considered to be of particular relevance

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"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 August 1997	2 7. 08. 97

Name and mailing address of the ISA	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+ 31-70) 340-2040, Tx. 31 651 epo nl, Fax (+ 31-70) 340-3016	Bossen, M

1

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